

THE BIOLOGY OF *DYNASTES TITYUS* (LINN.)  
IN MARYLAND (COLEOPTERA: SCARABAEIDAE)

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ABSTRACT

The larval biology of *Dynastes tityus* (Linn.), a large eastern dynastine scarab, has been investigated in Maryland where larvae have been found to develop in oak tree holes. Details of distribution, abundance, and larval activity are presented and discussed in relation to the activities of other tree hole scarabs such as *Osmoderma* and *Phileurus*. Competition for the same larval niche may be a factor affecting the distributions of *Dynastes* and *Osmoderma*.

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INTRODUCTION

*Dynastes tityus* (Linn.), widely known to most coleopterists as the largest of the eastern dynastine scarabs, occurs over nearly the entire Atlantic and Gulf Coastal Plains as well as north through the Mississippi Valley. The beetle is relatively common in some southern states, and has upon occasion been taken in large numbers. Manee (1915) reported collecting many hundreds of specimens on ash (*Fraxinus*) trees in North Carolina during the course of a summer, and as many as 387 from a single tree. Such experiences appear exceptional, however; most of the specimens in collections have been taken singly, chiefly at light.

Published information concerning the larva or larval biology of *D. tityus* is scarce. Some aspects of the life history of the species were discussed by Chittenden (1899), and the third stage larva was described and keyed by Ritcher (1966). Manee (1915) reported finding larvae in "rotting side roots of old pine stumps" at Southern Pines, North Carolina, whereas Ritcher (1966) listed decaying cherry (*Prunus*), black locust (*Robinia*), oak (*Quercus*), pine (*Pinus*), and willow (*Salix*) as larval hosts.

LARVAL BIOLOGY

My observations indicate that all of the larval associations reported above with the exception of oak are atypical, at least in Maryland, and moreover that the habitat relative to oak is apparently far more specific than decaying wood *per se*. Based on investigations in the field over the past 2 years, chiefly in the Maryland Coastal Plain, it has become clear that *D. tityus* undergoes larval development in tree holes or cavities in the trunks of various species of oaks. Following the initial discovery of this fact, an intensive examination of tree holes in all types of hardwoods and conifers was undertaken, during which more than 600 such cavities were investigated. My early suspicion that oaks were indeed the larval host of *D. tityus* has been borne out by the results. Some 400 or more larvae, pupae, and adults were taken from approximately 80 tree holes, all but 2 of the cavities in oaks. The 2 exceptions noted were a single third stage larva in a



cavity in a mature tulip tree (*Liriodendron tulipifera* L.), and 5 third stage larvae found in a basal tree hole in a bitternut hickory (*Carya cordiformis* Wang.).

The tree holes selected by *Dynastes* are almost invariably large cavities at or near the bases of the trunks of mature trees. Trees with such cavities, and in particular oaks, tend to occur in groups rather than singly within a given tract of woodland, a fact consistent with the probable origin of the cavities as a consequence of scarring by ground fires. The scars admit a variety of fungi which pervade and progressively destroy the heartwood, ultimately resulting in an open cavity floored with a deep accumulation of granular woody debris. Access to the cavity, for both the beetle and the collector, is through an opening a few inches wide to several feet in diameter. Oaks with tree holes sufficiently large to accommodate full larval development of a beetle the size of *Dynastes* are nearly always mature.



Fig. 1. Basal tree hole in mature oak—typical larval niche of *D. tityus*.



Very old oaks with trunk diameters of 1 to 1.5 meters are far more likely to contain basal cavities than younger, smaller trees (Fig. 1).

*Dynastes* larvae feed exclusively in the granular debris which collects at the base of the cavity, converting it to characteristically flattened, rectangular fecal pellets about 10 mm long. In most instances, the feeding depth ranges from a few centimeters to 45 cm below the surface of the debris, but larvae have been dug out from as deep as 76 cm. Oviposition apparently takes place in Maryland in August, as female beetles are rarely encountered in tree holes prior to the first week in August. Eggs, typically white to dirty-yellow elongate ovoids measuring 4-5 mm in length, have been taken from the debris in the holes in early October; 12 such eggs collected on October 13, 1975, hatched within 3 to 7 days. First stage larvae (about the size of a penny in curled position) have been collected in November and reared to adult beetles under artificial conditions. The fact that these larvae fed for 22 months before pupation lends support to Ritcher's (1966) suggestion of a 2-year life cycle, but inasmuch as feeding continued unabated throughout the winter months in a heated basement, the life cycle of *Dynastes* in nature may be as long as 3 years in Maryland. Moreover, some large cavities have yielded grubs in all stages of development as well as pupae or unemerged adults, indicating repeated oviposition in the same tree hole until all food material has been exhausted.

Some assessment of brood size can be made from the numbers of same stage larvae, pupae, or unemerged adults encountered in individual cavities. The range in numbers is large—1 to 91—with an average of 14. Both very low and very high numbers of larvae are questionable brood estimates, and may simply reflect high larval mortality at the low end and multiple oviposition in a single season at the opposite end of the scale. The latter is almost certainly true in the case of a single large tree hole which yielded 91 adult *D. tityus* as well as numerous larvae and eggs.

Pupation of third stage larvae begins in Maryland by early August. A thick-walled oval cell of woody debris and fecal pellets is constructed by the larva within the material in the cavity, generally a few centimeters beneath the surface. Moreover, the cells are commonly tightly grouped—1 cavity examined contained 18 such cells in a space  $30 \times 30 \times 10$  cm. The pupal stage lasts until late September, or 6 to 8 weeks; Chittenden (1899) cites 51 days for reared individuals. By the last of September, I find only newly-transformed beetles in cells where they remain until normal emergence during the following June or July. I have taken numerous adult *D. tityus* by digging out cells from tree holes during the winter months. Such winter collecting offers the welcome advantage of relative freedom from unpleasant surprises provided by opossums, skunks, sundry birds, and nesting honeybees, all of which also frequent tree holes. Also of interest is the preponderance of males over females in almost all of the individual broods examined. In fact, the aggregate ratio of males to females is nearly 2 to 1.

#### DISTRIBUTION IN MARYLAND

It is instructive to examine certain aspects of the distribution of *D. tityus*, particularly in Maryland and the states north and east of Maryland. Plotted in Figure 2 are locality records for this species in the area north of the Maryland-Virginia boundary, based on data compiled from the litera-

ture, institutional collections as cited, and my observations. The data suggest that the Southern Maryland Coastal Plain and probably the Delmarva Peninsula hold the northernmost breeding populations of *Dynastes* with scattered records in Pennsylvania, New Jersey, and Long Island representing stragglers. In Anne Arundel County, just south of Baltimore, the northern limit of common larval activity is well marked and falls at about mid-County, about 24 km. (15 miles) south of the city. Although the abundance of oaks and tree holes remains much the same throughout the County as well as to the north and northeast of Baltimore, evidence of larval feeding decreases rapidly northward, and none has been found in forested areas above Baltimore despite a concerted search.

#### ZOOGEOGRAPHY OF TREE HOLE SCARABS

Oak tree holes are utilized in Maryland by the early stages of scarabs other than *Dynastes*, in particular *Osmoderma eremicola* Knoch and *O. scabra* (Beauv.), and probably *Phileurus castaneus* Hald. The larval biology of *Osmoderma* has been discussed by Hoffman (1939) and Ritcher (1966), and is fairly well understood. In Maryland, *O. eremicola* undergoes larval development in tree holes, chiefly in oaks but occasionally in other hardwoods, and has larval feeding habits closely similar to those of *Dynastes* including a preference for cavities at the base of the trunk. Unlike

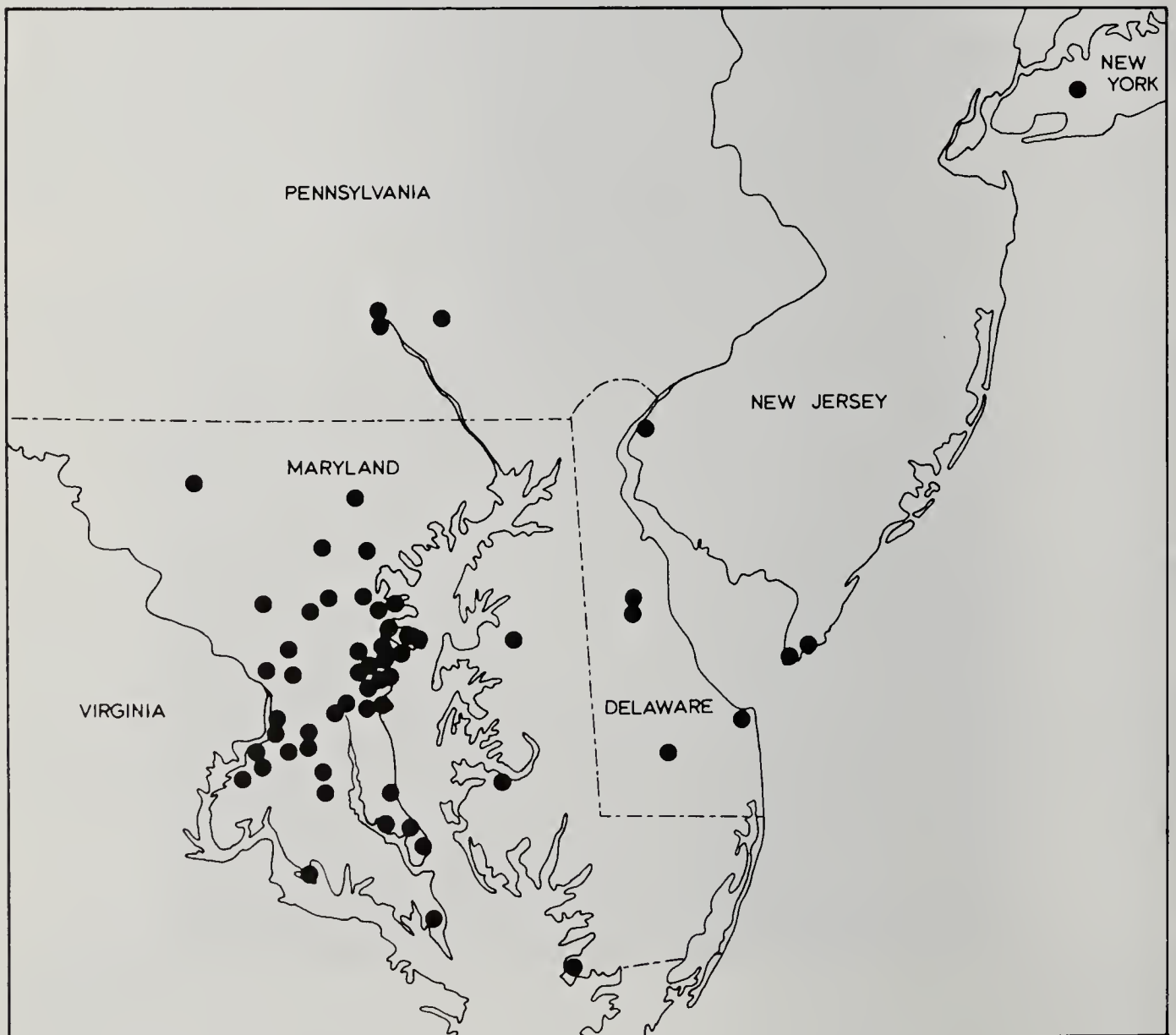


Fig. 2. Distribution of *D. tityus* north of the Maryland-Virginia boundary.



*Dynastes*, however, *O. eremicola* may at times be found in cavities higher in the bole or in large lateral branches. Larvae of *O. eremicola* are common in central and western (Piedmont and Appalachian) Maryland, considerably less common in the eastern and southern Coastal Plain portions of the State, and rare in the southernmost counties.

*O. scabra* is far less selective in larval habitat, and may be encountered not only in tree holes of all types but also under bark of standing dead trees, stumps, and logs of a variety of hardwoods. Further, this species is practically confined to the Piedmont and Appalachian provinces of the State.

In my experience, larvae of *Osmoderma* and those of *Dynastes* are never found feeding in the same cavity. Moreover, the distributions of the 2 taxa in Maryland are nearly allopatric with a zone of overlap in the inner Coastal Plain. The range of *Dynastes tityus* in North America and that of the genus *Osmoderma* (Fig. 3) suggests a similar degree of isolation. *Dynastes* is doubtless a relatively ancient element in the American fauna, perhaps established by Miocene time (Howden, 1966). It is also likely that this genus survived the Pleistocene glaciations in North America along with many other scarabaeid groups in hardwood forest refugia in Florida or other Gulf Coast areas. If so, the present distribution of *D. tityus* parallels the reinvasion by the deciduous forest of the Atlantic Coastal Plain and the Mississippi Valley beginning about 14,000 yrs. B. P. (Maxwell and Davis,

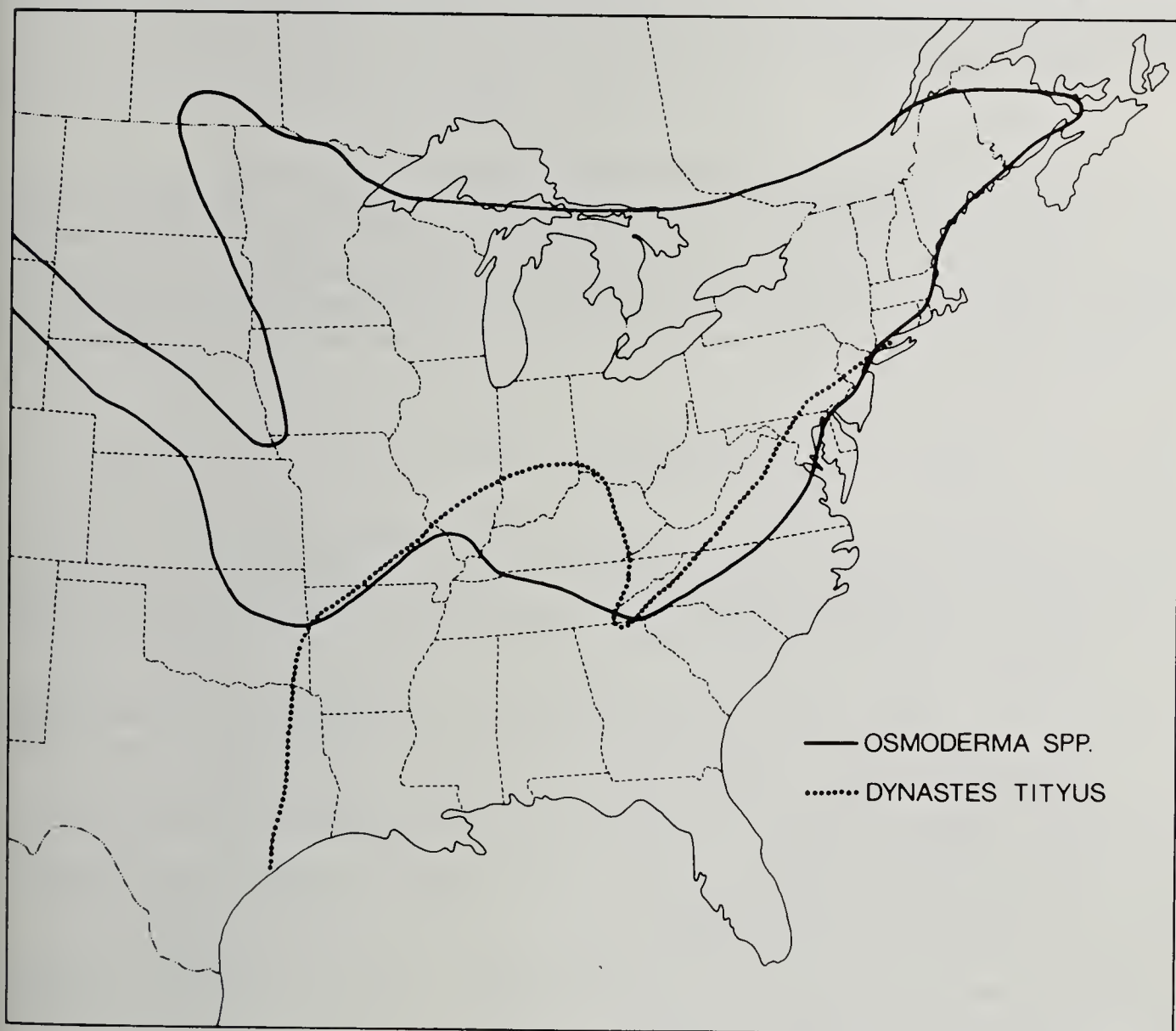


Fig. 3. North American distribution of *D. tityus* and aggregate range of *Osmoderma* spp. (*Osmoderma* distribution from Howden, 1968).

1972). *Osmoderma*, on the other hand, appears to be a more recent invader from the Old World fauna, possibly even post-Wisconsin. The close similarity among Asian, European, and American species as well as the typically northern distribution of the genus in North America appears to bear out this supposition. If this was indeed the case, the present separation of *Osmoderma* and *Dynastes* may reflect competition for the same environmental niche more than any other factor.

Earlier reference was made to the dynastine *Phileurus castaneus* Hald. as a probable tree hole associate. Some brief discussion of the biology of *Phileurus* is pertinent although the available data are insufficient for meaningful conclusions. Literature distribution records and my observations point to Southern Maryland as the northern limit of this species. I have taken a half dozen specimens in Charles County, all from oak tree holes, but none have been associated with larvae nor have any unassociated larvae from this niche been reared to *Phileurus* adults. However, numbers of a congener, *P. truncatus* (Boh.), were obtained from larvae and pupae dug from oak tree holes in Myrtle Beach State Park, South Carolina. In this instance, most of the cavities containing *Phileurus* were located high in the boles of largely hollow, dead trees with severed crowns. Presumably, then, both species of *Phileurus* utilize tree holes, again primarily in oaks, for larval development. The type of cavity and its location within the trunk may differ from the typically basal cavity preferred by *Dynastes*. However, the evidence bearing on this point is meagre, and final conclusions must await further investigation.

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